CASE REPORT

Cardiac Magnetic Resonance Imaging in a Patient with Implantable Cardioverter-Defibrillator

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ROGUIN, A., ET AL.: Cardiac Magnetic Resonance Imaging in a Patient with Implantable Cardioverter-Defibrillator. The presence of pacemakers and implantable cardioverter-defibrillators (ICD) is considered historically a contraindication to magnetic resonance (MR) imaging. This image modality has unparalleled soft-tissue imaging capabilities, and many consider it as the image of choice for patients with arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C). ICDs are now smaller, with less magnetic materials and improved electromagnetic interference protection. We tested modern ICDs for heat, force, function and image distortion and found that several of them may indeed be MRI safe. We report here a patient who was suspected of ARVD/C, underwent ICD implantation based on MR safety testing, and underwent intentionally scheduled follow-up cardiac MR imaging. This is the description of a patient with an ICD who had planned MRI scanning. The scan was safe and most of the MRI images were of high quality. (PACE 2005; 28:336–338)

ARVD/C, cardioverter-defibrillator, MRI, pacemakers, safety

The presence of pacemakers and implantable cardioverter-defibrillators (ICD) is considered a contraindication to magnetic resonance (MR) imaging.¹ This image modality has unparalleled soft-tissue imaging capabilities, and many consider it as the image of choice for patients with arrhythmogenic right ventricular dysplasia/cardiomyopathy (ARVD/C).² ICDs are now smaller, with less magnetic materials and improved electromagnetic interference protection. We tested modern ICDs for heat, force, function, and image distortion and found that several of them may indeed be MRI safe.³

We report here a patient who was suspected of ARVD/C, underwent ICD implantation based on MR safety testing, and underwent scheduled follow-up cardiac MR imaging.

A tall-thin 23-year-old male (1.82 m/60 kg) was referred for evaluation of ventricular tachycardia and echocardiographic evidence of right ventricular dilatation. Thorough evaluation was suggestive of ARVD/C, and ICD implantation was recommended. However, based on the inflammation findings in the heart biopsy, it was felt that the patient would need in the future MR follow-up. Therefore, based on our in vitro and in vivo study of pacemaker and ICD system evaluation in the MR environment⁴ we decided to implant an ICD model and lead that proved to be safe, and to schedule a follow-up MR imaging.

Single-chamber ICD Model V-197 (Epic VR, St. Jude Medical) was positioned in the subpectoral position connected to a Riata 1580 65-cm lead that was implanted in the right ventricle. The procedure went uneventful and the patient returned for MR follow-up 5 weeks later.

A study on clinically indicated MRI of patients with permanent pacemakers and ICDs was approved by the Institutional Review Board. Risks and benefits of MR imaging were discussed, and informed consent was obtained. The ICD was turned off. The patient was imaged with an ICD in place using fast spin echo, triple IR, SSFP, and post-contrast T1 sequences. During the scan, the patient’s pulse and saturation were monitored, resuscitation equipment was ready and experienced electrophysiologists were present. Similar to the in vivo animal studies,³ image quality and distortion was dependent on scan sequence and plane (Fig. 1). Quantitative evaluation could not be performed due to the ICD and lead artifact. The MR finding was concluded as similar to the baseline scan and compatible with ARVD/C with involvement extending to the left ventricle. A full interrogation was performed before, immediately after the scan and at 1 week. The ICD was evaluated to have normal functioning before and after the imaging, with no change in any of the parameters. The patient did not feel any pulling of the device or pain. Three weeks after the scan, the ICD detected two episodes of ventricular tachycardia that were treated appropriately. At last follow-up, 7 months after the MR scan, the device is functioning

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Received November 13, 2004; accepted November 25, 2004.

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appropriately with no change in sensing and pacing parameters (Fig. 1).

We presented a patient who underwent ICD implantation with intentional plan to have cardiac MR scan at follow-up. The published data of MR imaging in patients with ICD is scarce, and describes those who underwent inadvertent MR imaging scanning (usually of the brain). The MR imaging in our patient resulted in satisfactory interpretation without any damage to the device or other safety problems. Furthermore, the device was able to detect and properly treat ventricular arrhythmia during follow-up. Of note, our patient was especially thin, therefore the ICD was implanted in the subpectoral position, with shorter distance between the ICD can and the heart. In more obese patients, this distance would increase allowing less artifact due to the ICD can. The lead artifact is 2–3 mm, and does not substantially distort the image. We believe that patients with certain ICD devices could be eligible for MR scans under appropriate medically necessary circumstances. This may have major clinical implications on imaging practice as performed today.

Figure 1. The ICD lead in the superior vena cava in the Sagittal FGRE view (A). The ICD creates a void (*) that obscures the superior part of the heart in the coronal FGRE (B). Artifact (white arrows) created by SSFP imaging results in our inability to quantitatively evaluate function (C). Blood black imaging (FSE triple IR), showed enlargement of the right and left ventricles, with global decreased contractility, irregularity of the wall of the right ventricle, with increased signal within fibers of both the right ventricle and the left ventricle consistent with fatty infiltration (D). After gadolinium administration (E), the lead void (black arrows) can be seen. There was enhancement involving the anterior right ventricular wall, as well as the wall of the left ventricle.
References


